

Technical procedure guide: Detection and elimination of ruddy ducks in France



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Figure 1: Fight between two males, a ruddy duck (below) and a white-headed duck (above); © E. Médard

Preface

This guide provides the managers responsible for the control of ruddy ducks with the technical elements tested in France to achieve the objective of eradication in different contexts. It describes the necessary conditions prior to any field operation (detection and identification), the tools and the operational methods using shooting or trapping. These methods, tools and techniques are adapted to the biological cycle and the ecology of the species (place of occurrence, season). Finally, the conditions for reporting are described in detail (taking measurements, preservation of tissues, transmission of information).

1 Context

1.1 The ruddy duck in Europe, a threat to the conservation of the white-headed duck

The ruddy duck (*Oxyura jamaicensis*) is a duck native to North America. A few specimens were imported to the UK in the 1950s for collecting purposes. Some of the juveniles issued from breeding of these birds escaped into the wild and emancipated. They initially colonised the UK, reaching 6,000 individuals in 2000. This population has also spread across the European continent, with the first sighting reported in France in 1974. In recent decades, this species has also been bred in captivity, by amateurs and in some zoos.

The white-headed duck (*Oxyura leucocephala*) is a Eurasian species related to the ruddy duck. It used to be common in France and nested in Corsica until the 1960s. Isolated individuals, probably from the Spanish population, are often observed on French territory. This species is endangered (EN) in its now fragmented range, which extends from Spain and Morocco in the west to Kazakhstan in the east. The Spanish population is estimated at around 2,000 specimens, having reached a minimum number of around twenty specimens in 1977.

In addition to the problem of the quality and destruction of its wetland habitats, the white-headed duck is also threatened by the development of ruddy duck populations when they come into contact with each other. During the breeding season, the male ruddy duck is more aggressive (Figure 1) and fertilises the female white-headed duck, creating hybrids that are fertile. The risk of losing the integrity of the genetic heritage of the white-headed duck through introgression of the ruddy duck genes has greatly concerned the Spanish authorities, who have called for complete control of the growing ruddy duck population in Europe.

Due to its central location between the Nordic countries with significant numbers of ruddy ducks and the presence of the birds on its territory, France plays a key role in limiting the risk associated with the establishment and spread of the ruddy duck in Spain. Since 1996, the French Biodiversity Agency (OFB, formerly the National Office for Hunting and Wildlife) has carried out control operations on its territory. These actions were carried out as part of a control plan, the French declination of the European plan for the eradication of the ruddy duck in the Western Palearctic, supported by the Council of Europe.

In 1996, the ruddy duck population in France was around fifty birds; in 2005, it reached around 300 individuals, with the birds occurring mainly in the west of France (particularly in Mayenne). The OFB's first interventions were mainly on large groups of birds in autumn-winter from watercraft supported by a few shooting stations on the edges or settled on water bodies. They were aimed at limiting the number of birds at the national level and took place after the breeding season. This approach neglected breeding birds, which were generally isolated and more discrete. These control measures stabilised the French population at around 250-300 birds before a decline was observed following the reassessment of the national control plan in 1996 and a better consideration of breeding birds.

The implementation of the LIFE NAT project /FR/000542 entitled "LIFE Oxyura" in 2018 aims to implement the recommendations of this new 2015-2025 plan, in particular through the deployment of a team within the



OFB dedicated to these detection and sampling actions. This technical project has benefited greatly from the technical and strategic progress made by the British since 2006. Indeed, the large British population (5,000 - 6,000 individuals) justified the implementation of a LIFE project, LIFE DEFRA, which was carried out between 2006 and 2015. This programme made it possible to virtually eradicate the species in this country and reduce the number to less than 100 individuals at the end of the project by recruiting people committed to its eradication.

1.2 Measures to combat the ruddy duck in France

The measures introduced in Spain and the UK in the early 1990s largely inspired the OFB and the National Society for the Protection of Nature (SNPN) in France.

The measures implemented are adapted to the biology of the ruddy duck. Like most anatids, ruddy ducks are generally gregarious between breeding seasons. They tend to leave the small bodies of water in which they breed to congregate in a limited number of larger sites, each of which may harbour several hundred or even several thousand individuals. In the UK, it is estimated that the 10 most important sites harbour more than 80% of the total population in winter. In France, 95% of the birds congregate at Grand-Lieu Lake (south of Nantes, west coast), which can cover up to 6,000 ha in winter.

The actions carried out in the UK were mainly autumn and winter actions, putting considerable pressure on the large wintering sites. These operations, carried out from boats with shooters on board armed with hunting rifles, enabled a rapid reduction of the British population. In addition, control operations were carried out during the breeding season, focussing on shooting females with small calibre, silent rifles. To compensate for disturbance to other populations of native birds during the breeding season, this project recommended interventions of no more than 5 hours every 2 weeks. In preparation for the LIFE Oxyura project, a transfer of skills and experience from the UK teams to the OFB and SNPN took place in 2013 and 2014. This allowed the OFB agents to benefit from the technical knowledge of the DEFRA agents regarding both the tools to be used (weapons, boats) and the methods.

However, the main particularity of the management of the French duck population is that it is not possible to collect individuals when they are gathered in the Grand-Lieu lake in winter. Apart from the size of the lake and the climatic conditions that prevail there, which do not facilitate navigation or hunting from boats, the ruddy ducks display an escape behaviour by flying at a great distance from the boats (200 to 300 m) and over long distances (sometimes 500 m). This peculiarity renders obsolete any attempt at rapid pursuit by boat or concentration of birds by drifting, attempts already made by the OFB and SNPN in the 2000s.



Figure 2: Male ruddy duck. (a) breeding plumage; © E. Medard (b) nonbreeding plumage; © F. Schulenburg

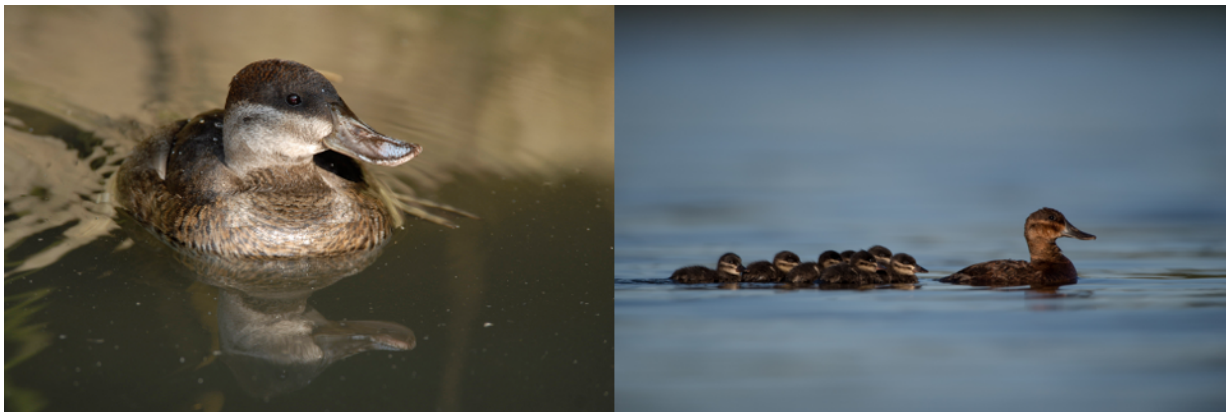


Figure 3: Female ruddy duck. (a) alone; © M. Benmergui (b) with its ducklings; © E. Médard

The ruddy duck



The white-headed duck



Figure 4: Morphological differences between the ruddy duck and the white-headed duck; © S. Nicolle

2 Inspect favorable water bodies and detect the presence of the ruddy duck

Apart from the winter period when ruddy ducks settle on Grand-Lieu Lake and remain inaccessible, the eradication of the population requires being able to spot them on pre- and post-breeding sites. Recognising a ruddy duck within a group of Anatidae or coots requires sufficient knowledge of its morphology, plumage, habits, the community of ducks with which it cohabits and the preferred habitats it favours. Recognition becomes easier with experience, but remains tricky due to the bird's discretion. Various factors can make identification difficult, such as light, the time of day in relation to the bird's activity, vegetation, proximity to other Anatidae, etc.

2.1 Identify

The ruddy duck is a small diving duck (slightly larger than a teal) with pronounced sexual dimorphism. During the breeding season, the males are easier to recognise. They have a blue bill, an orange-brown body, white cheeks, a black cap and the black tail is erect most of the time (Figure 2). Certain features of the male are attenuated during moult and then in nonbreeding plumage. The crown and nape are chestnut and mottled light grey, the light chestnut brown of the body gives way to a light to blackish grey, depending on the different parts of the bird. The bill becomes dull, while the white cheek remains (Figure 2).

The female and the young birds have a much simpler plumage. The plumage remains the same despite the moult: brown body, beige-brown cheek and a brown band under the eye in the centre of the cheek (Figure 3). Juvenile birds resemble adult females but have a more striped plumage, making it difficult or impossible to determine the age and sex of these birds from a distance. Ducklings are blackish on the top and sides, grey on the shoulders; their bellies are dirty white. The white cheeks are crossed by a large brown-black bar that extends from the beak to the neck and runs under the eye (Figure 3). Males and females can be seen together or alone. During the breeding season, the presence of a male, which is easier to recognise due to its blue bill and behaviour, can be accompanied by that of a female in the nest, which is not immediately detectable.

2.2 Do not confuse

The ruddy duck can easily be confused with the rare white-headed duck, but also with other anatids with similar plumage or appearance, especially females.

2.2.1 with the white-headed duck

Regardless of sex, age and period of observation, the ruddy duck differs from the white-headed duck in having a shorter body and tail and a bill with a concave profile (and not curved at the base). The undertail is white or white striped (not dark brown striped). The sizes are similar (Figure 4).

However, the risk of confusion with the white-headed duck is limited if the birds are on the water and can be observed under good conditions. Shooting must be preceded by formal recognition.

The presence of hybrids is possible and a number of phenotypic variations have been observed in Spain. Icona and the Donana National Park have published a very complete identification key in French for the white-headed duck, the ruddy duck and their hybrids (Urdiales & Pereira, 1993¹). These hybrids can be collected in the same way as the ruddy duck. Confusion is also possible with other species of the genus *Oxyura*, such as the Argentine duck (*O. vittata*), the Maccoa duck (*O. maccoa*) from Africa and the Southern duck (*O. australis*), which is native to Australia.

¹Urdiales, C., Pereira, P., 1993. Identification Key of *O. Jamaicensis*, *O. Leucocephala* and Their Hybrids, Icona.



Figure 5: Different Anatidae possible to confuse with the ruddy duck. From left to right and top to bottom: *Tachybaptus ruficollis* © R. Knight; *Podiceps nigricollis* © D. Brossard CC BY-SA 2.0; *Podiceps cristatus* © G. Winterflood ; *Aythya ferina* © R. Zh CC BY-SA 3.0; *Aythya fuligula* © R. Kasambe ; *Aythya marila* © MPF; *Melanitta fusca* © F. Vassen CC BY 2.0 ; *Melanitta nigra* © M. Berntsen CC BY-SA 4.0; *Netta rufina* © G. Vellut CC BY 2.0; *Spatula querquedula* © F. Chu CC BY-DA 2.0; *Spatula hottentota* © D. Keats C BY 2.0

2.2.2 with other species

The ruddy duck can be confused with other species, such as the little grebe *Tachybaptus ruficollis*, the black-necked grebe *Podiceps nigricollis*, the great crested grebe *Podiceps cristatus*, the common pochard *Aythya ferina*, the tufted duck *Aythya fuligula*, the greater scaup *Aythya marila*, the velvet scoter *Melanitta fusca*, the common scoter *Melanitta nigra*, the red-crested pochard *Netta rufina* and the garganey *Spatula querquedula*. The presence of exotic anatids can also lead to confusion, especially with the blue-billed teal *Spatula hottentota* (Figure 5). The risk of confusion mainly affects females, juveniles and males in nonbreeding plumage.

2.3 Detect its presence

Detecting the presence of individuals in water bodies at a national level can be a delicate task. However, the contribution of participatory science, knowledge of the ecological needs of the species and the experience of previous years (in particular recurrent observations on certain water bodies) make it possible to consider a strategy for the targeted detection of water bodies affected or likely to be affected.

2.3.1 Identification of waterbodies with potential occurrence

Identification of waterbodies suitable for breeding consists of selecting historical sites where the species has been reported, reports from ornithologists and using available knowledge of habitats likely to harbour ruddy ducks in spring/summer. The waterbodies visited are of medium size (3-10 hectares) and have a relatively lush riparian forest (Touradon, reeds, rushes) and aquatic vegetation (water lily, various sea grasses). The use of cartographic databases on habitats favourable for reproduction remains difficult due to the lack of sufficiently accurate national databases.

A complementary approach is to use an “indicator” species with a similar ecology: the more widespread common pochard. In this way, an initial selection of ponds to be studied can be made based on the presence of this species reported on ornithological platforms.

2.3.2 Inspect

The previously selected waterbodies will be surveyed from March to September. In spring, during the breeding season, the male shows a demonstrative behaviour that makes it easier to find. The males are in search of a mate and explore several bodies of water. Ruddy ducks form loose, non-monogamous, often short-lived pairs. Once they are paired, they often migrate along the shore, with the female searching for nesting sites and the male defending his territory from other males. During the nesting season, the females may be less detectable. The presence of a male is a good indicator of the presence of a female. The hatching season can extend into September for late broods, so surveys must be continued until the end of September.

In autumn and early winter, the birds leave the waterbodies where they have been staying and look for larger bodies of water (10 hectares or more). Ducks can then be observed in the lagoons of sewage treatment plants, where they find plenty of food. In winter, behaviour on the Grand-Lieu lake is gregarious and individuals gather in large groups near or among other duck species and coots. Monitoring of the population in the heart of this lake is carried out by the national nature reserve ideally every 10 days. Occasionally, when the water inside the lake freezes over, nearby rivers (such as the Loire or the Erdre) can serve as a refuge (resting place).

In general, the search for ruddy ducks on a body of water requires patience and must be carried out in favourable weather conditions. The water is searched with a telescope by scanning it several times (Figure 6). During the various passes, the speed at which the water body is scanned can lead to false-negative results (bird present but



Figure 6: Use of a telescope in different conditions



Figure 7: Material used during inspections: device to diffuse birdsongs, teleguided decoys, nautical equipment

not detected), especially during the breeding season (April to July). It may be advisable to use several vantage points to get a complete overview of the water body, which is often not circular. The frequency of scouting can be once a fortnight in places with regular traffic. In the post-nuptial period, when the juveniles disperse, it is advisable to increase the frequency of visits to once a week.

Very often this targeted search is facilitated by reporting ruddy ducks through participatory science on natural history or ornithological platforms.

During the mating season, detection can be improved by using a device with loudspeakers (Figure 7), which broadcasts the sounds emitted by the male to attract them. The sounds are available at the following links: <https://www.xeno-canto.org/169402>; <https://www.xeno-canto.org/109911>. This method can also attract females to a lesser extent before egg-laying. The ideal device for broadcasting the soundtrack is a Bluetooth speaker, that is easy to transport and transmits far enough. However, you need to be careful when broadcasting birdsongs as in some cases it seems to tend to keep the birds away. This has been observed particularly for females with eggs or chicks. It is therefore necessary to scout the site carefully before using it and not to use it as a default setting when you arrive at the water body.

Night detection is also mentioned in the literature as an effective means of identifying birds. It involves first identifying where the birds park in the evening and then using a night light. This technique was tested on Grand-Lieu Lake in optimal weather conditions and resulted in no sightings of ruddy ducks.



Figure 8: Shooting operations



Figure 9: Preparation of a shooting operation

3 Collect ruddy ducks

The aim of detecting ruddy ducks on bodies of water is to collect them under the best conditions (Figure 8). The control measures are regulated by prefectural decrees issued for the management of invasive alien species. The content of these decrees is set out in Article R. 411-47 of the Environment Act. These decrees are issued by the prefect of the department and instructed by the departmental directorates for territories (and the sea) in collaboration with the regional directorates for the environment, planning and housing.

Before each intervention, the field staff must ensure that the decree of the department concerned is effective. If this is not the case, a simplified procedure is possible with the departmental directorate for territories (and the sea). This provision makes it possible to avoid the lengthy procedure with the Regional Scientific Committee for Natural Heritage (CSRPN).

If a ruddy duck is reported via a participatory platform and there is no photo to confirm this, a confirmation visit is required before any action is taken. If the bird is not spotted, another visit should be made the next day and it may also be useful to explore neighbouring water bodies. If the bird is absent, a final inspection must be carried out 8 to 10 days later. If the bird reported during the breeding season is a female, the attention needs to be longer and a round should be carried out a month later, when the female has hatched her eggs.

Once the presence of birds has been confirmed, proceed as follows when performing a control operation:

- Verify the existence of a decree or emergency decision;
- Contact the owners or the manager;
- Secure the site;
- Carry out control measures;
- Report via a mission sheet (positive and negative), see Appendix A;
- Perform analyses and inform a national database

3.1 By shooting

3.1.1 Secure the operation

The safety rules for field operations are a priority and must never be neglected (Figure 9). Depending on the location of the body of water and its size, operations can be carried out by 2 agents (up to 3 ha), one equipped with a weapon, the other with binoculars or a telescope, or both equipped with weapons. In certain configurations of large bodies of water, the use of more agents (up to 5-6) may prove effective, some on the water (in hiding places or in boats), others in hiding on land.

Liaising with the owner or manager in advance will provide information on the use and habits of visitors and help to secure the site. The knowledge of the site that you obtain from this manager or another person in charge of the site makes it possible to assess all risk areas (path, house, farm, road, etc.). Reading the aerial photos available on the Internet is also an essential element for assessing distances and danger points. In this way, you can position the shooter(s) and recognise a possible need for technical reinforcement for observers and shooters.

This analysis should also help with the choice of weapons: only smooth-bore rifles with a short range (50 metres) or only one or two rifles with a much longer range but the risk of ricochets.

The presence of observers who are not shooters facilitates the smooth running of operations, as they are safe and have a complete view of the waterbody. Using the spotting scope and binoculars, they will communicate the bird's location in real time via walkie talkie or Whatsapp. They may also be responsible for communicating with users and the public. Some people may also dedicate themselves entirely to this task. Informing users of the body of water and its immediate surroundings is also accompanied by the installation of information and explanatory signs on the day of the operation (Figure 9).



Figure 10: Weapons used. (a) smoothbore rifle caliber 12 cambered 89; (b) .22 long rifle carbine; (c) .17 HMR carbine; (d) .22-250 carbine; (e) .222 carbine

3.1.2 Prepare and have the right equipment

Weapons to use

Equipping yourself with reliable weapons and high-quality optics for rifles is essential for the smooth execution of various operations. Not all weapons are suitable for different locations, and a prior analysis of the operating mode helps determine whether to use smoothbore rifles or carbines.

The smoothbore rifle caliber 12 cambered 89

This weapon (Figure 10) is the most commonly used and boasts the highest success rates. It can be employed in all situations and has the advantage of firing shot (weaker and less dangerous ricochets). Unlike rifles, shot allows you to target both flying and stationary birds. The drawback of this weapon remains its limited range (maximum 50 m). The use of three-shot semi-automatic rifles without manual rearming increases the likelihood of a lethal shot. 12 gauge rifles chambered 89 with a barrel length of 71cm can be used, but a 76cm barrel extends the range. The rifle can be equipped with external chokes of the BRAIN or PATTERNMASTER type, reducing the shot pattern and enhancing shot lethality at 50m.

The choice of ammunition is crucial for maximizing the chance of hitting the bird. The “X-TREM” cartridge from the Mary-Arm brand provides the highest satisfaction. It consists of spherotungsten (steel) balls of size No. 6 and a 50g charge in chambered 89. The large powder charge and the skirt-type lead cup enable reaching birds at considerable distances. The No. 6 ball provides a good balance between regularity and the strength of the shot pattern.

The .22 long rifle carbine

Two models from different brands have been tested: a bolt-action rifle from ISCC and a linear reloading rifle from CZ (Figure 10). Regarding technical specifications, the CZ seemed more practical but is less reliable in use than a standard bolt-action model. High-quality optics are essential for this type of weapon, and the use of a HAWK VANTAGE IR 4-16X50 scope may be sufficient, but higher-end ranges provide more robustness. The use of these scoped rifles requires adjustment, preferably at a shooting range, to fully utilize the shooting potential, which ranges between 50 and 100 meters. These weapons should be equipped with a suppressor (e.g., SAK) to minimize disturbance in natural spaces.

Bullet-type ammunition is inexpensive and easy to obtain. CCI Segmented 2.6g/40grs rounds are effective and have the unique feature of dividing upon impact, thereby limiting potentially harmful ricochets. Other models like CCI Subsonic 2.59g/40grs can be used but provide less safety in terms of ricochets.

The .17 HMR carbine

This bolt-action rifle offers great shooting versatility (50-150 meters) and high precision but has the drawback of being rather noisy despite the presence of an original suppressor (Figure 10). CCI V-Max 1.1g/17grs ammunition can be used for this carbine. The ammunition and equipment are less common than for the .22LR but remain easy to obtain.

The .22-250 carbine

This rifle has the longest range (distances from 100 to 200 meters) and is reserved for particularly large bodies of water, notably Lake Grand-Lieu (Figure 10). This weapon is particularly dangerous outside of this context and is not recommended. The bullets are precise but shatter on impact, with the risk of injuring other species when birds are grouped. The SAVAGE 110 VARMINT model equipped with a HAWKE FRONTIER 5-25X56 FFP MIL scope and an ATEC CMM6 suppressor is suitable.



Figure 11: Nautical means used. (a) canoe; (b) motorized boat; (c) float-tube; (d) hiding-boat

The .222 carbine

After use, a more common and less noisy caliber, such as the .222, seems more appropriate (Figure 10).

The most accurate bullet tested for this rifle is the Norma V-Max Plastic Tip 3.2g/55grs. They are harder to find and are usually only available by order.

Nautical means

Operations on certain bodies of water may require the use of nautical means, whether motorized or not.

The canoe

The canoe kayak is an effective and versatile tool (Figure 11). This maneuverable vessel can navigate in areas with shallow waters and allows for quick and silent approaches. Some canoes can be equipped with an electric motor for operations on bodies of water covering a few hectares. It is used to gently guide birds towards shooters positioned on the banks without causing them to take flight. On board, the 12-gauge is most recommended, but for silent approaches, the .22 Long Rifle is compatible. In case of bad weather with wind, it is no longer suitable due to suboptimal stability.

Motorized boat

Primarily used on large bodies of water, it allows for rapid movement and guiding of birds (Figure 11). It has several drawbacks, such as the need for a launch site or dedicated space, the transport of a trailer, fuel usage, and noise. Approaches are very limited and often result in little to no success, except when the boat is positioned well to allow for drift with the engine off. As birds take flight quickly due to the noise and the movement of the boat, the use of a 12-gauge is most recommended.

Boats have been utilized to pursue birds as quickly as possible, tire them out, make them take flight while cutting off their trajectory for shooting. This technique can be effective on large groups (a few dozen birds). A 40hp motor is necessary for this approach. This technique can work on ponds ranging from 30 to 60 hectares but causes excessive disturbance to all species on the water. Untargeted ducks may also leave the water, which they don't do in other situations. They may also assume a "cork" position, becoming invisible with only the tip of their beak showing to breathe. Stopping operations for a few hours sees the birds resurface. This technique is also fuel-consuming.

The float-tube

Easily transportable and discreet, the float-tube can be useful for reaching positions near dense aquatic vegetation (reed beds, willow groves, sedge tussock) (Figure 11). Shots with a 12-gauge can also be taken from the float-tube once the shooter is in position. Good camouflage attire is recommended. However, movement is slow and somewhat impractical (backward progression).

Hiding-boats

A fully camouflaged boat with side openings for weapon use (12-gauge and rifle) can be strategically positioned on a body of water (Figure 11). It serves as a blind while being movable as needed to reach a better site. It can also be used to push birds towards shooters, but this function is not easy. The bulky side of the boat concerns the birds, but by positioning it a few days before operations, it can be assimilated as a landscape element by ruddy ducks.



Figure 12: Shootings from fixed-positions



Figure 13: Shootings after approaching

Equipment maintenance

All the mentioned equipment must be operational before any operation. Weapons must be used with care and regularly maintained. Rifles must be adjusted regularly to ensure shooting performance. Small equipment such as decoys, walkie-talkies, and a rifle support stick must be of high quality and in working order for the operation to succeed.

3.1.3 Carrying out the operation

On-site, on the day of the operation, and once the bird or birds are detected, the operation leader briefs all participants. This point serves to reiterate instructions, especially regarding safety (shooting angles), and to assign roles and locations on the body of water to each participant. This moment is an opportunity to clarify the communication mode (walkie-talkie) and its proper use (functional equipment and avoiding information overload). A well-organized and swift operation minimizes disturbance to the other species on the site.

Additionally, if the presence of females is confirmed, shooting them should take priority over potentially shooting males, to have a greater impact on population renewal.

Shooting from a fixed-position

Shooting from a fixed position involves either hiding on the edge of the body of water or in a blind on the water (Figure 12). This position has been previously discussed as a possible strategic point known to other potential shooters. In the case of duo operations, using decoys during the breeding season can preferentially attract males but also females. Decoys can reveal birds not observed until then on the body of water. Using decoys can result in killing about 80% of contacted birds at this time. The 12-gauge is preferred in this method because birds approach within 25m. In larger operations (multiple ambushed shooters and a boat on the water), the boat's objective is to push the birds towards a shooter; the shooter will not use decoys in this configuration.

In the specific case of Lake Grand-Lieu, shooting from blinds along the edge did not yield satisfaction in winter due to the lake's large surface and the low probability of birds passing near the blinds (Figure 12). Nevertheless, creating such fixed positions or using existing blinds on hunted bodies of water or for bird watching purposes (visitors not present during operations) can be useful.

Shooting after approaching

This method is used when decoys do not attract the bird, and the fixed position is too far from the bird. The shooter's movement occurs after the operation leader's approval and after informing all other potential shooters. Wearing a complete camouflage outfit that hides the face and hands, and using waders or chest-high boots, allows the shooter to advance as close to the bird as possible (Figure 13). Using riverbank vegetation as a means of camouflage allows attempting an approach as quickly and discreetly as possible without causing the bird to flee. The .22 Long Rifle is the most effective weapon in this situation, although the use of the .17 HMR and the .22-250 is also possible. However, these last two weapons are limited in terms of safety.

Shooting from a boat

Shooting from a boat is possible but requires skill. Generally, shooting from the boat occurs when the birds are flying just above the water. The use of 12-gauge shotguns is required. Sometimes, shooting is done at full speed, and the shooter's dexterity must be total. This task is therefore reserved, if necessary, for an experienced shooter. Shots from a canoe are possible and are done when it is stationary, using the .22 Long Rifle with a suppressor or the 12-gauge when the bird is nearby.



Figure 14: Conditions of captivity for birds used as decoys



Figure 15: Behavioral testing of decoys in a zoo

3.2 By capture

3.2.1 Capturing with live decoys

Capturing ruddy ducks using cages requires the use of one or more captive birds previously acquired and used as decoys. Placed in a cage, these individuals attract wild birds and capture them in adjacent cages. “Baited” trapping (with food), practiced to band diving ducks such as common pochards and tufted duck, is ineffective due to the ruddy duck’s diet mainly composed of plants and invertebrates.

Holding ruddy ducks in captivity

According to European Regulation 2014/1143, the captivity of ruddy ducks is prohibited. In French law, an exception exists for research institutions and establishments involved in ex-situ conservation of this species. Detention is allowed under the condition of a capacity certificate, attesting to the holder’s ability to raise this species in good conditions, and a prefectural authorization specifying the location of bird captivity. Reproduction of these birds is prohibited. The birds used as living decoys are generally from captivity and handed over to the authorities. Birds in illegal situations may also be recovered by competent authorities. Birds born in captivity are more easily adaptable and resistant to the stress of captivity.

Maintaining captive birds requires infrastructure, maintenance, and care, but remains simple and inexpensive for this species, which is relatively easy to raise. When not used for capturing wild ruddy ducks, the birds must have the minimum requirements for their well-being: a basin with relatively clean water, good nutrition (waterfowl maintenance feed, floating ducks/shorebirds), periodic deworming (via capsules or dewormed feed, once or twice a year). The enclosure must be predator-proof by burying the fencing in the ground. An area or means of easy bird retrieval should be considered.

Two types of enclosures are possible: the always-watered fenced enclosure or the aviary. The watered enclosure is less expensive. A high point sheltered with a gentle slope for access should be arranged. This point allows birds to go dry (even if they spend little time there) and includes the feeder. This option allows for clearer water for a longer time. The aviary has an area of 15 to 20m² and is equipped with a basin with a filtration pump to maintain water cleanliness. A large basin is not necessary (at least 2m² and 50cm deep) and should be surrounded by non-aggressive gravel or fine-mesh grids to avoid mud formation in winter (Figure 14). The feeder is placed on the ground but covered to keep the feed dry. Plants like “carex” and shrubs can be planted, but if a shelter is already present, it is not essential. This enclosure requires a water supply and a power outlet nearby.

Capture period

The pre-nuptial and nuptial periods are the most favorable for capture (April to August). Males actively seek females, and interactions between individuals are maximized. Decoy birds can be of both sexes. This technique mainly attracts males, but some females can also be captured. This capture bias may be less effective in limiting young production because one remaining male can mate with all females. Furthermore, the presence of many males at a site can also be used as an indicator of nesting females.

Making prototypes of cages

The construction of capture cages must adhere to some characteristics suitable for Anatidae. The size of the cage and the capture mechanism can be adapted to the human and material resources available. The goal is to keep the cage relatively mobile, which implies restrictions on its size. The entire cage is supported by floats (containers) so that the water always reaches the base of the entrances. A remote capture tracking system is

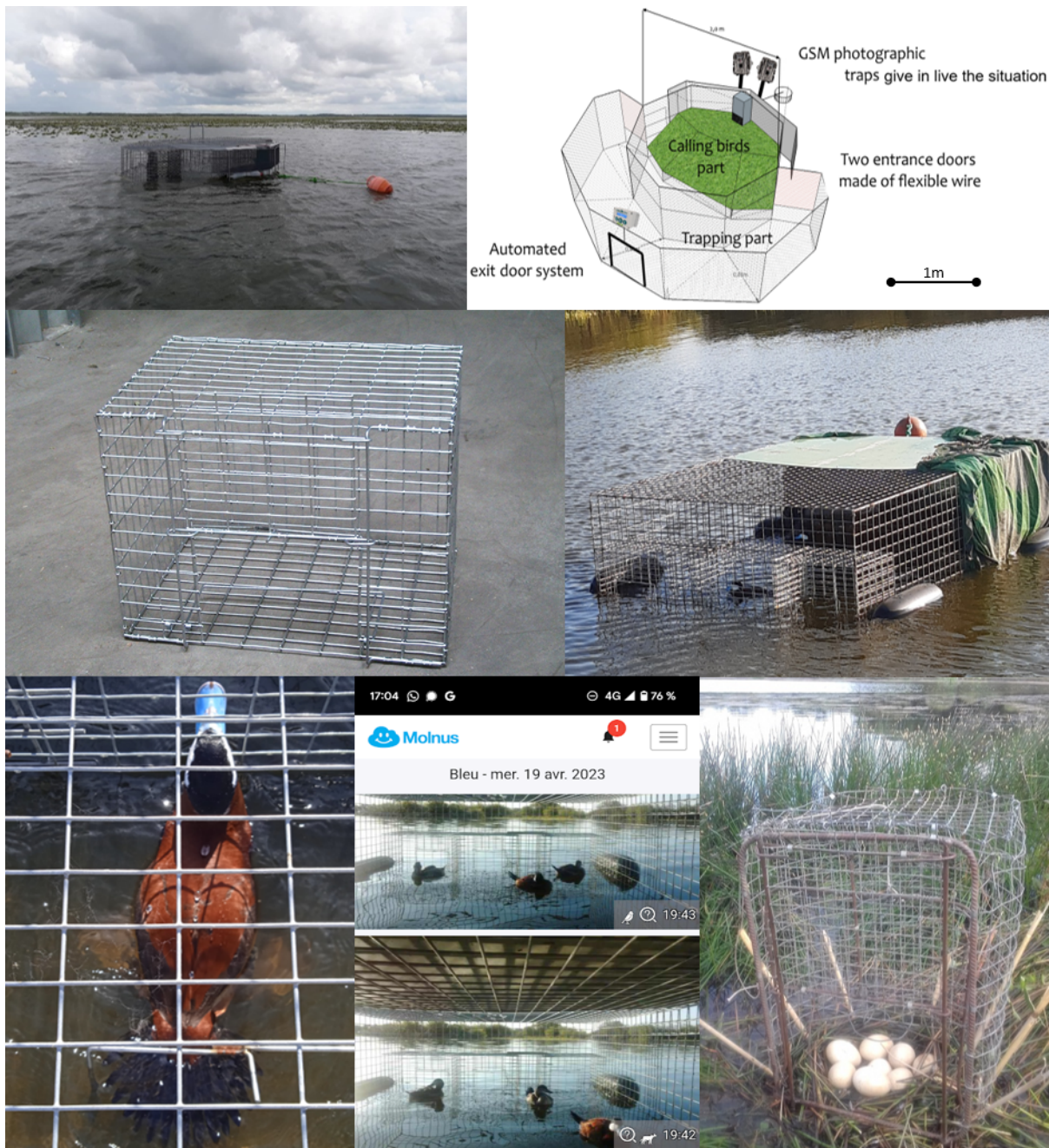


Figure 16: Different systems of trapping, from left to right and top to bottom: (a) and (b) fish trap system; (c) to (e) Drop-door pigeon traps system; (f) example of the remote capture tracking system platform; (g) nest-trapping system

possible to minimize the number of visits to the cage. This both reduces disturbance to wildlife and frees up time for agents in charge of trapping.

The cage is divided into two distinct parts: the part reserved for decoy birds and the part reserved for capturing wild individuals. The part reserved for decoy birds consists of a platform above water and sheltered from the elements, a feeder, and an aquatic area accessible by a ramp. Since the cage is floating, it is anchored, which must always be fixed to one of the corners of the above-water part. This attachment prevents waves from entering the above-water part since the cage will automatically align itself with the wind. The part reserved for decoy birds has been tested in controlled zoo conditions to verify that the decoy birds exhibit healthy behavior (Figure 15). Two entry systems (fish trap and drop-door pigeon trap types) have been tested.

Fish trap system

On the fish trap-type capture prototype, the part reserved for decoy birds consists of a hexagonal cage (2m in diameter by 1m in height), while the part dedicated to capturing wild individuals is composed of a trap with two entrances disconnected from the decoy section. There is no automatic closing system, and the capture is passive, with the funnel-shaped entrances preventing the birds from escaping (Figure 16). The significant drawback of this model is its size and weight. Indeed, a large cage will always be challenging to balance for buoyancy and will be much more susceptible to bad weather conditions. Additionally, the weight makes any maneuver more complicated and requires larger nautical means to deploy.

Once the cage is designed, it is necessary to test its buoyancy in real conditions and correct it if necessary. Once validated and possibly corrected, the test with decoys can begin in the spring. This test was conducted with common pochards, relatively common on Lake Grand-Lieu, to assess the technical capabilities of this model. Over a two-month period, no common pochard could be captured, probably due to a design flaw related to the position of the funnels, which do not face the decoys. The mesh forming these funnels may also not have been flexible enough, preventing the entry of birds. This feedback was not positive, and a second, lighter capture prototype with a drop-door system was developed.

Drop-door pigeon cage prototype

A second prototype consisting of several pigeon cages in a larger trap (a hunting decoy cage) was modified. With a size (2m x 1m x 0.80m; L x W x H) and weight much more modest than the fish trap prototype, buoyancy balancing is easier. This cage has a meshed platform for the bird to stay above water and also receive food placed in a feeder. The capture mode is an active capture system with small individual capture cages measuring 21 x 31 x 21 cm. These cages are available from agricultural supply vendors. A single drop-door ensures the bird's entry, and when the bird presses on a bar, it triggers the door's closure. Three of these individual cages are positioned inside the decoy cage (Figure 16) and communicate with the outside through a drop door. The cages are installed so that the birds enter by swimming and trigger the door's closure. After a buoyancy test, a testing phase was conducted with common pochards. This test resulted in the capture of three male common pochards in one week, validating the tool's operability.

Implementation of the trapping prototype

The capture of ruddy ducks using decoys began on Lake Grand-Lieu on 27/03/2023. The cage was positioned in a partially riparian area known to be frequented by ruddy ducks before and during reproduction. The first capture took place almost a month after displaying the cage and placing the decoys. In total, 11 birds were eliminated using the cage (from 27/03/2023 to 05/06/2023), including nine captures (8 males and 1 female) and two shot with a rifle (2 males) at the edge of the cage. Once captured, the birds are ethically eliminated by a blow to the head. Depending on the riparian area and water level variations, the cage may need to be moved. Remote monitoring using GSM camera traps facilitates tracking captures and interventions (Figure 16).



3.2.2 Capturing females on their nests

Capturing females during incubation is a heavy, resource-intensive, and disruptive method for the ecosystem. Targeting an area involves finding a male exhibiting highly territorial behavior during the breeding period, indicating the presence of a female. Finding the nest is challenging because females choose sites with often thick vegetation around the nesting site. The nest is often discovered when the female escapes from it or when she has already left. Once the nest is detected, a specific capture cage needs to be positioned above the nest (Figure 16). This cage encompasses the entire nest and has an active closure system triggered by the female upon her return. This technique has the advantage of eliminating the female and the clutch before hatching. However, during the five years of the LIFE project, only one capture was achieved after numerous hours of searching. This operation was combined with searching for common pochards nests as part of a dedicated program for that species.

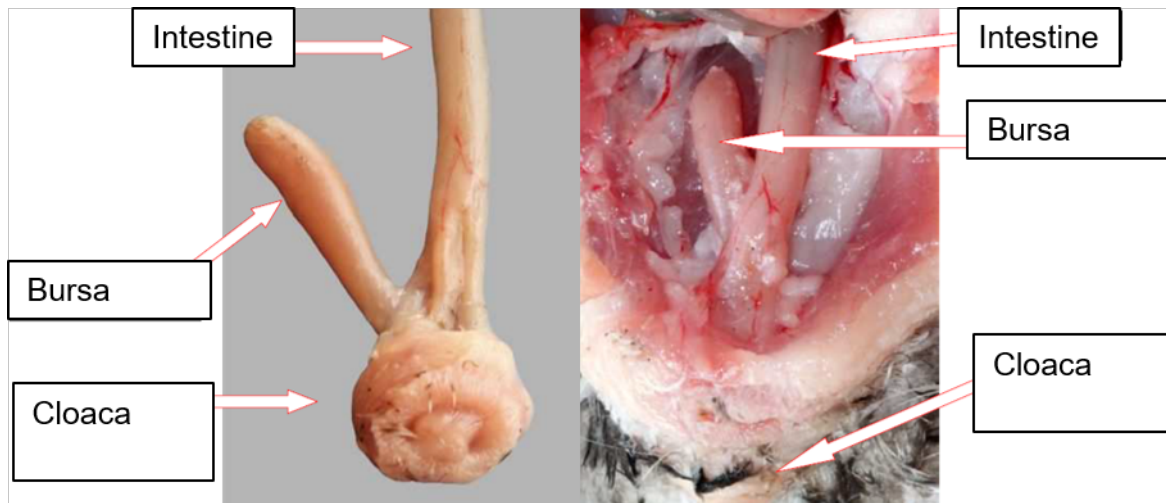


Figure 17: Bursa of Fabricius in a six-months old ruddy duck (on the right, the bird is lying on its back)



Figure 18: Sex identification in the ruddy duck. (a) penis of a juvenile; (b) penis of an adult; (c) female cloaca (the white spot is uric acid)

4 Collecting post-mortem data

Interannual variations in population numbers are attributed to fluctuations in reproductive success, migratory events, and mortality rates directly influenced by the harvesting rate. The number of adults harvested relative to the wintering population informs us about the harvesting rate, while the proportion of juveniles in the harvest provides insights into reproductive success. Determining the age of birds is crucial for understanding population variations. The sex of harvested birds is also an important indicator, as, in the majority of duck species, males outnumber females and are therefore not limiting for reproduction. It is more effective to harvest females than males to reduce the reproductive success of the following year. Collecting samples from killed individuals is to be done conservatively and with the potential for genetic analyses.

4.1 Age determination

Birds born in the spring reach adult size in about six weeks but have the plumage of an adult female until the winter molt preceding the next breeding season. An analysis of their external appearance does not allow them to be distinguished from adults. However, juveniles have an internal diverticulum along their intestine called the “bursa of Fabricius”, visible upon dissection, which resorbs after about eight months. The bursa of Fabricius is a gland that opens into the cloaca (Figure 17). Located on the dorsal side of the bird, it is frequently concealed by the intestine. The diagnosis can be made by carefully opening the abdominal cavity with a scalpel to expose the intestine to the cloaca. If a bursa of Fabricius is present, it appears at the junction between the intestine and the cloaca, on the right side of the bird (left side when the bird is lying on its back, facing the observer). The bursa of Fabricius is elongated and has the same color and appearance as the intestine. Care should be taken not to confuse it with the penis or the oviduct, which do not have the same shape or color as the intestine and are located on the opposite side of the bursa of Fabricius.

4.2 Sex determination

Males are only distinguished from females by their plumage in adulthood. Therefore, plumage of the female type does not allow a conclusion about the individual’s sex before this stage. A proper cloacal examination can detect the penis in males regardless of age. It is small in juveniles (but always visible) and extremely developed in adult males. In the latter, it has rough patches. To check for the presence of a penis, the cloaca should be spread apart using both thumbs while applying strong dorsal pressure. The penis of adult birds only partially emerges, with the tip remaining invaginated into the abdomen (Figure 18).

If there is any doubt, a dissection of the abdominal cavity can be performed to complement the examination. Females have a single ovary, which is high on the dorsal side and the left side of the abdominal cavity. It consists of hundreds of tiny white spheres (future eggs), difficult to distinguish in young females. The testicles of males are also located on the dorsal side, high in the abdominal cavity, resembling large grains of rice, varying in size according to age and season. Observing these organs requires the removal of the entire visceral mass.



4.3 Tissue collection for future genetic studies

Collecting a small piece of tissue and preserving it allows for medium to long-term population genetic studies. Preserving a piece of flesh is preferable to a feather, which would need to be pulled from the bird's skin (Figure 19). Moreover, between each sample, the scissors or scalpel used will be cleaned with water to avoid any contamination. Wearing gloves is recommended.

Sample type	Quantity	Collection	Short-term storage (few-months)	Long-term storage (several years)
flesh	Piece of 1cm square	To cut of with scissors or a scalpel	ethanol 95° ambient temperature	ethanol 95° -20°C (freezer)
feathers	One or two	Pulled from the bird's skin	Exposed to air ambient temperature	Exposed to air ambient temperature

Figure 19: Different sampling and storage conditions for genetic studies

Once the samples are available, their quantity and distribution among populations can help address various questions, depending on the molecular markers used. For instance, using sex markers allows confirmation of individuals' genders when identification is challenging. Comparing the genetic profiles of ruddy ducks and white-headed ducks also enables the identification of hybrid presence (F1, F2, or backcross generations) in the sampling. If samples from different localities are available (a minimum of 30 samples per locality), it is also possible to identify gene flows between these locations, indicating migration events followed by reproduction at the receiving site. Finally, when a sufficient number of samples is available (the quantity depending on each species, reproductive behaviors, fertility, age at sexual maturity, overlapping or non-overlapping generations, etc.), it is possible to estimate parameters related to population size. All these analyses rely on hypotheses that need verification, and depending on the available sampling, the species considered, and the molecular markers used, not all analyses may be feasible.

5 Conclusion

This guide reviews the various methods applied during the LIFE Oxyura project to eliminate the wild population of ruddy ducks in France. Significant expertise has been gained regarding detection methods, surveying, shooting, trapping, and data collection.

These methods were adapted to the situation of the ruddy duck population in France, which has the peculiarity of wintering on a single very large body of water and then dispersing to multiple small bodies of water in spring and summer. They have led to a reduction of over 80% in the wild ruddy duck population in France over four years. However, to be effective, these methods required significant human and technical resources.

Exchanges with other managers involved in ruddy duck control, particularly in the UK, helped initiate these different methods before adapting them. This highlights the need to exchange and share the experience gained in any invasive species management operation. This guide has been written with this goal in mind.



A Annexe : Mission sheet



Programme d'éradication de l'érisma rousse

Fiche intervention



NOTA : cette fiche doit être remplie lors de toute tentative d'intervention sur un site, même infructueuse.

Date :	N° dépt :	Rédacteur :			
Commune :		Nom du site :			
Nb total d'érisma rousse observées avant intervention (y compris poussins)					
Dont mâles taille adulte					
Dont femelles taille adulte					
Dont sexe indéterminé taille adulte (grands juvéniles, mâles en mue...)					
Dont nichées :		Nids :			
Nb d'individus	Tués	Blessés	Nb d'individus	Tués	Blessés
mâles adultes			âge ou sexe indéterminés		
femelles adultes			Canetons non volants ⁵		
mâles juvéniles			Nids et œufs		
femelles juvéniles					
Si l'aspect du plumage de l'oiseau ne permet pas de déterminer son sexe ou son âge (en période d'éclipse ou pour les grands juvéniles), il est possible de le faire en tout temps par l'examen des organes de repro et la bourse de Fabricius.					
Technique d'approche des oiseaux					
<input type="checkbox"/> bateaux / Nb :		<input type="checkbox"/> postes fixes / Nb :		<input type="checkbox"/> autres méthodes, préciser (float-tub...):	
<input type="checkbox"/> canoé / Nb :		<input type="checkbox"/> postes mobiles / Nb :			
leurres	<input type="checkbox"/> appelants vivants	<input type="checkbox"/> repasse	<input type="checkbox"/> formes		
fusil	<input type="checkbox"/> Nb :	<input type="checkbox"/> cartouches / Nb :			
carabine 22 LR	<input type="checkbox"/> Nb :	<input type="checkbox"/> balles / Nb :			
carabine 17HMR	<input type="checkbox"/> Nb :	<input type="checkbox"/> balles / Nb :			
Carabine 22.250	<input type="checkbox"/> Nb :	<input type="checkbox"/> balles / Nb :			
pièges	<input type="checkbox"/> Type /Nb :				
Nb d'agents présents :			Durée totale de l'intervention :		
Intervention : <input type="checkbox"/> Facile <input type="checkbox"/> Difficile <input type="checkbox"/> Impossible					
Motifs ⁶ détaillés si difficile ou impossible :					
Commentaires :					